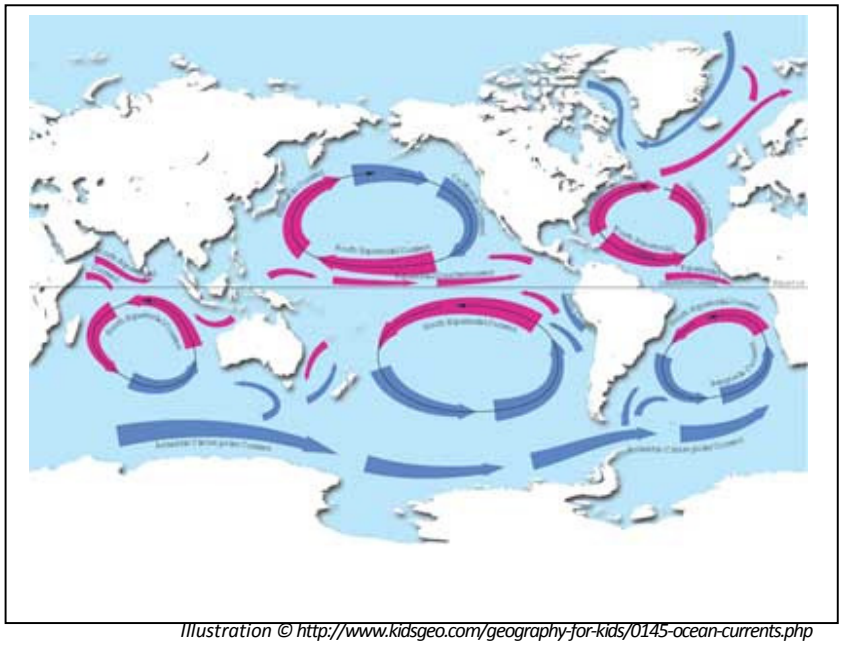
Lesson Plan: OCEAN CURRENTS AND WATER DENSITY
Class: 5th and 6th Class
Subject: Science
Strand: Energy & Forces
Strand Unit: Heat, Forces



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Aim / Learning Objective:

Through discussion and experiments involving energy and forces, students can learn about water density and what causes ocean currents. Students will become familiar with the features and movement of currents due to heat and forces as well as understand the effects of currents on the planet (e.g. how the ocean affects our climate and weather). These experiments can be conducted over a course of study.

Skills:

Students will have developed questioning and predicting skills as well as the following:

- Observation
- Investing and experimenting
- Estimating and measuring
- Analysing

Materials:

- Illustration of Ocean currents
- Materials required for experiments see instructions below.
- Some preparation needed in advance for making coloured ice cubes

Background:

What are Ocean currents?

Ocean currents are masses of water that flow in a definite direction from one place to another around the world. Currents are caused by differences in temperature, differences in salinity, and by wind.

What Types of Currents are there?

The world ocean consists of two types of currents:

- Surface Currents
- Deep Water Currents

Lesson Plan: OCEAN CURRENTS AND WATER DENSITY
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Surface Currents are caused by prevailing winds around the globe creating a continuous swift momentum of water movement. The moving water is subject to the Coriolis Effect. For example, in the Northern Hemisphere, water is forced to the right of the direction of the wind and in the Southern Hemisphere, the water is being forced to the left. The currents therefore end up moving at a 45 degree angle to the wind.

The wind patterns, the Coriolis Effect, and the arrangement of landmasses are responsible for large-scale patterns of wind-driven surface currents in the world ocean.

Deep Water Currents make up 90% of the world's oceans. They are slow moving which are caused by their density. These currents are denser (heavier) because they have a higher salinity (Salt) level.

Why are currents important?
Currents are important as they maintain the ocean waters at a stable low temperature. The ocean absorbs heat from the sun and stores it as it moves. The movement of warm and cool water helps warm and cool the air. This helps control our climate and weather patterns around the world.

Currents benefit all marine species by providing a transportation system around the seas. For example, ocean currents move plankton, fish, and different types of chemicals like salt, oxygen, and carbon dioxide around the world.

Discussion:
What causes currents?

- Discuss the vocabulary and language associated with currents: Fresh water, salt water, density, currents, surface currents, deep water currents, coriolis effect, climate change etc. Discuss our natural environment and generate ideas from the students about what causes currents.
- Use the illustrations of currents and identify the different currents that circulate around the world's oceans.
- Identify which currents move around Ireland.
- Introduce the following experiments and discuss the key causes of ocean currents:
    - variations in density
    - variations in temperature

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Activities:

1. Simple Density Experiment

Materials:

- Large jar, Maple syrup, Washing up liquid (green or blue are good colours), Water, Cooking Oil

Method:

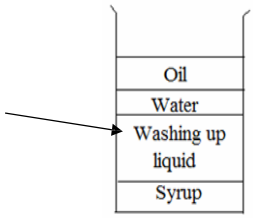
Discussion

Introduce the following experiment explaining how using liquids with different density naturally form layers.

Experiment:

- Observe and discuss the different types of liquids (i.e. density).
- Layer the liquids in your jar by pouring in the maple syrup first, then the water and then the oil. Add the washing up liquid last and observe what happens.
- Record the experiment explaining the density of liquids.

Washing up liquid sinks to the middle,
showing that it is denser than oil and water.



2. Showing Density using an "Egg Float"

Materials:

- Tall drinking glass, Glass or jar, Raw Egg, Tap water, Table salt, Tablespoon

Method:

Discussion

- Discuss how the Egg Float experiment will show the effects of density.
- Ask students if they have ever swum in fresh water and then ask if they have ever swam in salt water (i.e. establish if it is easier to swim or float in salt water rather than in fresh water such as a swimming pool).

Experiment:

- Complete the "Egg Float" experiment to demonstrate how the density of water can affect objects in it:
  - Fill the glass half full with fresh water
  - Carefully place the egg in the water
  - Get the students to observe what happens to the egg. *(It should sink to the bottom)*.
- Add salt to the glass one tablespoon at a time. Stir the salt into the water. Ask the students what is happening to the water when more salt is added. *(It is becoming denser).*
  - Predict how many spoonfuls it will take to get the egg to float. Keep adding salt to the water. When the egg floats to the surface, slowly add some more freshwater - dribble it down the side of the glass. *(The egg should float in the middle of the glass).*
- Have groups explain what happened when salt was added to the fresh water and how this would affect swimmers in salt water. Also, discuss how this would affect ships at sea. Extend the discussion and highlight how different species that live in the ocean have to adapt to different conditions of water density to survive. Adding salt to water increases the density of the water forcing the egg to float.

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3. Ocean Currents – Experiment A

See the following experiment to observe how temperature variations influence ocean currents. This experiment can be completed as a demonstration or the students can complete the exercise outside in small groups.

Materials:

- Old jars with flat rims and openings of the same size (spice and herb jars work well)
- Food colouring
- Fresh water and salt water (you can make your own salt water by adding 1/2 a teaspoon of salt to fresh water in one of the jars)
- Some plastic cards or thick cardboard squares larger than the opening of the jars
- Plastic tray or old biscuit tin
- Paper towels

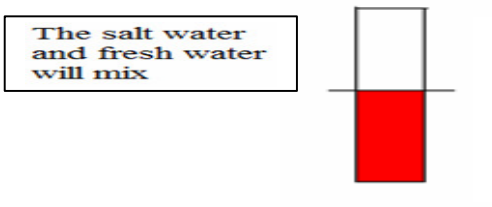
Method:

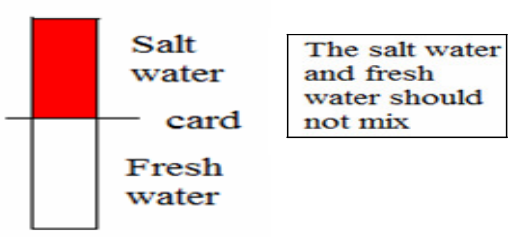
Discussion:

- Discuss with the students how the mixing of colder and warmer ocean waters has a major effect on the currents. Water near the Antarctic and the Arctic Ocean is very cold, while water near the equator is much warmer. At any location, surface water is warmer than deeper water.

Experiment:

- Fill one jar with fresh water and one with salt water. Add a drop of food colouring to the salt water. (Explain that the colouring is used to see the different types of water).
- Place both jars on the tray or tin, put the card on top of the salt water jar and invert carefully holding the card and jar. The card will be held in place by the upward pressure of air - *most of the time!*
- Place the salt water jar on top of the fresh water jar. Have a volunteer carefully remove the card – one person slides the card out while the other holds the jars together.
- Observe the results. *(The salt water and fresh water should not mix)*
- Repeat experiment but place the fresh water jar on top this time. *(The salt water and fresh water will mix)*
- Observe and record the difference in the results.
- Discuss how this relates to the water temperatures in the ocean.





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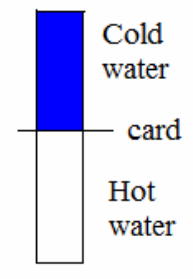
This experiment can also be carried out using warm and cold water.



The cold water and warm water will mix

The cold water and warm water should not mix

4. Ocean Currents - Experiment B

This is a variation of the Ocean Currents - Experiment A.

Materials:

- Glass bowl
- Jug of ice water
- Cup of hot fresh water
- Pepper
- Food colouring

Method:

Experiment:

- Fill the bowl 2/3 full with ice water. Sprinkle a pepper on the surface of the water. (Explain that is to represent the movement of the "currents").
- Place several drops of food colouring into the hot water. Slowly pour 1/4 cup of hot water into the bowl of ice water.
- Observe how the hot water stays on the surface. (Depending on the heat of the water, it may not be fully noticeable). Remind students when that the top layer of water stays warmer, the cold water is more dense and stays at the bottom.
- Discuss what keeps the water warm in the ocean.
- Observe what happens as the hot water cools. *(It should begin to sink, mixing with the colder water).* Also, note what happens to the pepper. *(It moves representing currents.)*
- Repeat the experiment, but reverse the position of the two temperatures of water. This time, start with a bowl of hot water. Pour coloured ice water into the bowl.

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5. Ocean Currents - Experiment C

This is a variation of the above experiments highlighting how currents move in the ocean.

Materials:

For discussion:

- Illustration of currents moving around the ocean.
- Globe

For the experiment:

- Frozen coloured ice (food colouring / ice cube tray / freezer – to be done in advance)
- Jug
- Rectangle fish tank or Glass baking dish
- Water

Method:

Discussion:

- In class using the globe, discuss with the students about how the oceans on Earth are one large world ocean. Explain that water from all the oceans are continuously mixing together and moving around the earth through a number of different currents. (Refer to the illustration showing the currents in the different oceans). Using the globe, ask the children where they think the ocean is the coldest. (e.g. Antarctic and the Arctic Ocean, or the Equator. Confirm that not only is the ocean coldest in the Antarctic and Arctic Ocean, but it is frozen solid).

Experiment:

- In advance, mix food colouring with water and pour the solution into an ice-cube tray. Freeze it.
- Half fill the glass dish with warm water. (Explain that this is a model of the ocean). Have two students place one ice cube at each end of the dish to represent the frozen oceans. Remind the group of the experiment they did with warm and cold water, and predict what will happen. (Explain that the ice cubes are coloured so they can see what happens to the cold water as it mixes with warmer water).
- Observe the motion of the cold (coloured) water. Where does it go? *(The cold water moves along the bottom, towards the warmer water in the middle.)*. Observe what happens to the cold water as it begins to warm *(It begins to dissolve).*
- Discuss and record what has been observed in the dish.
  (Help the students understand that the colder, heavier water from the Antarctic and Arctic Ocean moves along the bottom of the ocean toward the equator, where the water is warm. The warmer, lighter water from around the equator moves along the surface of the ocean toward the Antarctic and the Arctic Ocean where the water is cold. These movements are called currents. Because of currents, the cold waters and the warm waters of the world oceans are constantly changing places).
- Following the experiments, discuss questions such as:
  - Why do you think water on the surface of the ocean is warmer than the water in the deeper parts of the ocean?
  - How do you think currents affect species that live in the ocean i.e. fish found in different temperatures and depths of the ocean.
  - How do you think the currents affect our weather and climate on land?